

Overview of CCS in Canada

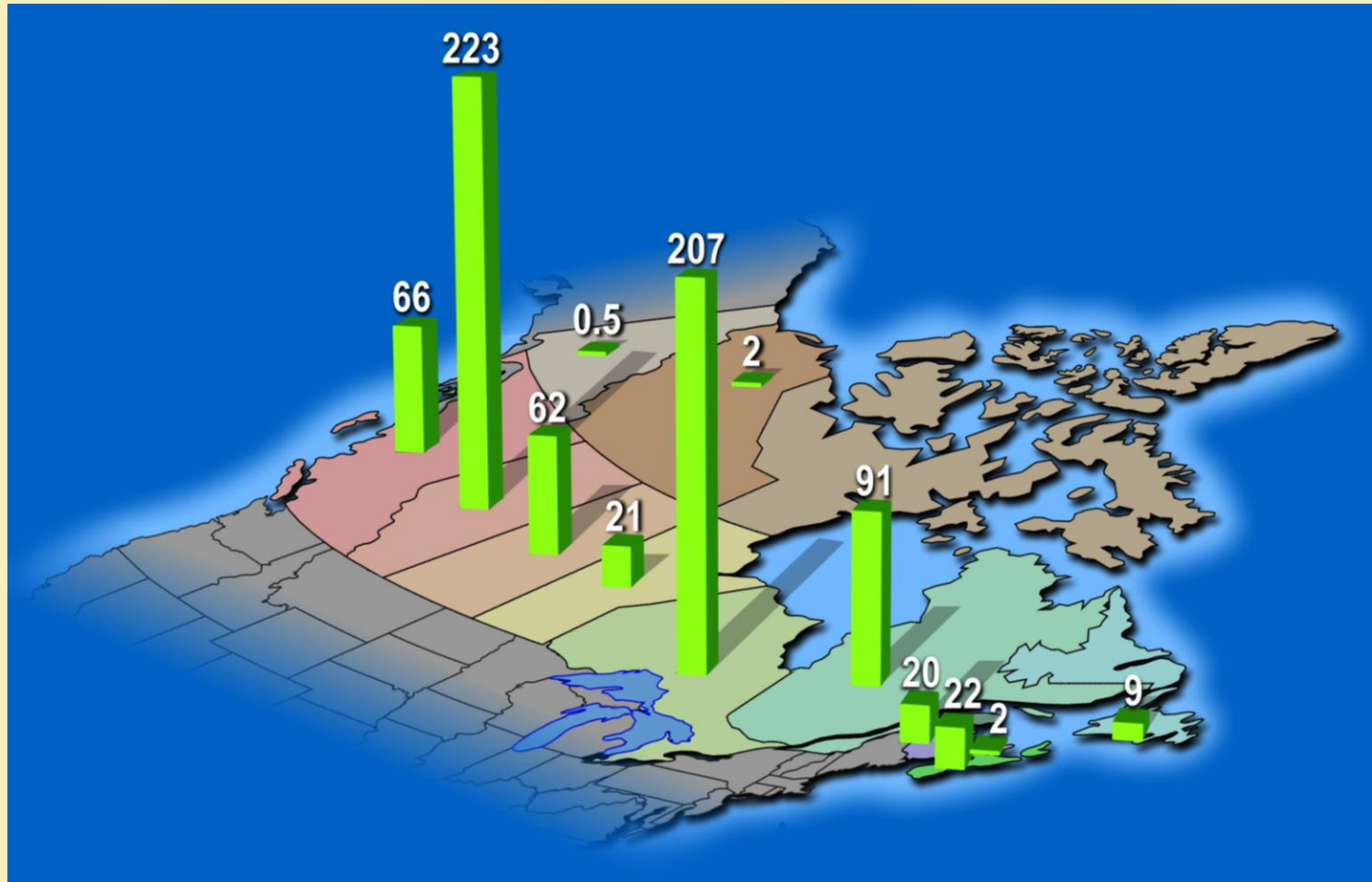
Dr. Stefan Bachu

Principal Scientist, CO₂ Storage
Alberta Research Council
Stefan.Bachu@arc.ab.ca

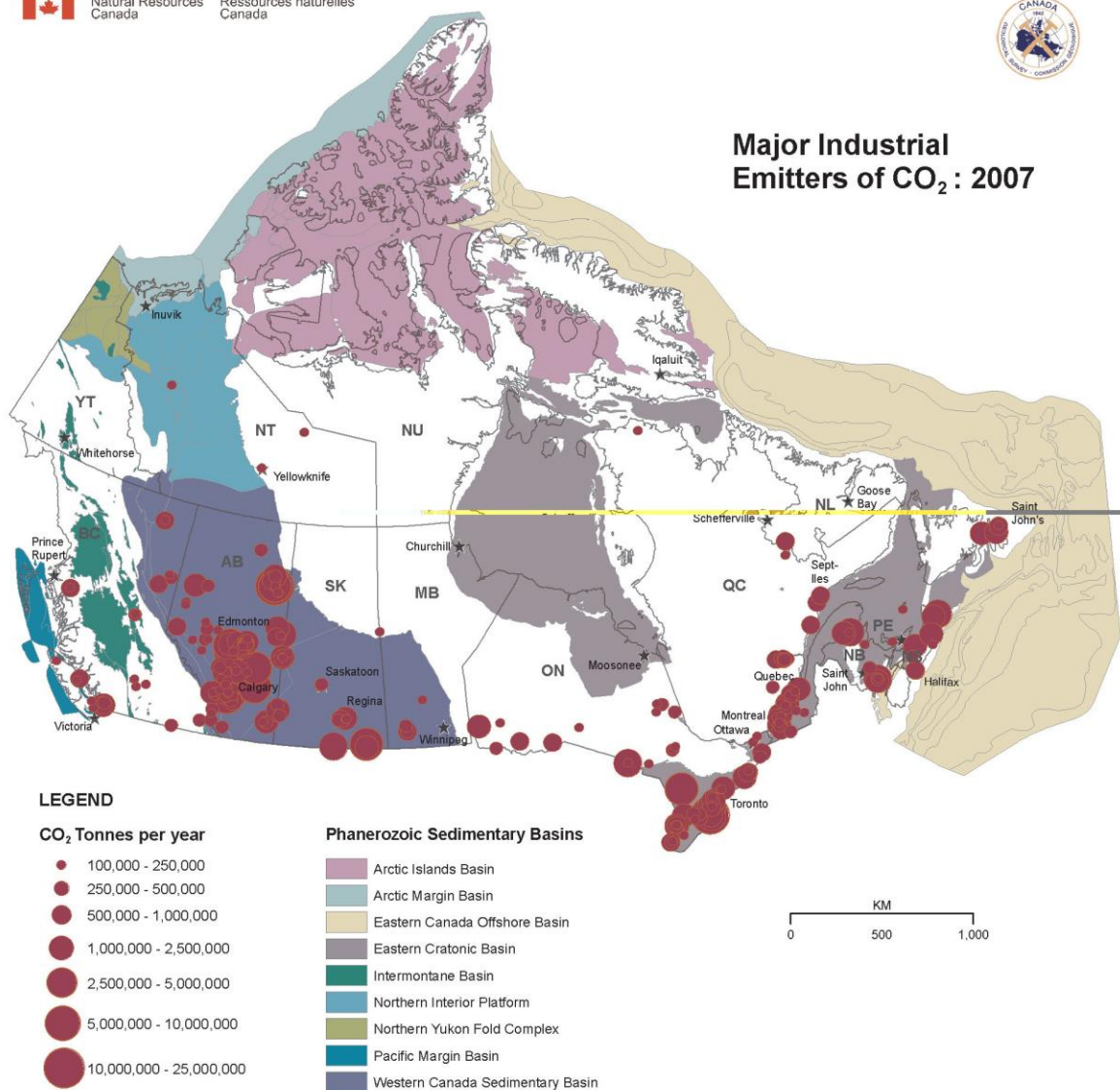
*Associate Editor
(Storage)*



Canada's 2000 CO₂ Emissions by Provinces (Mt)

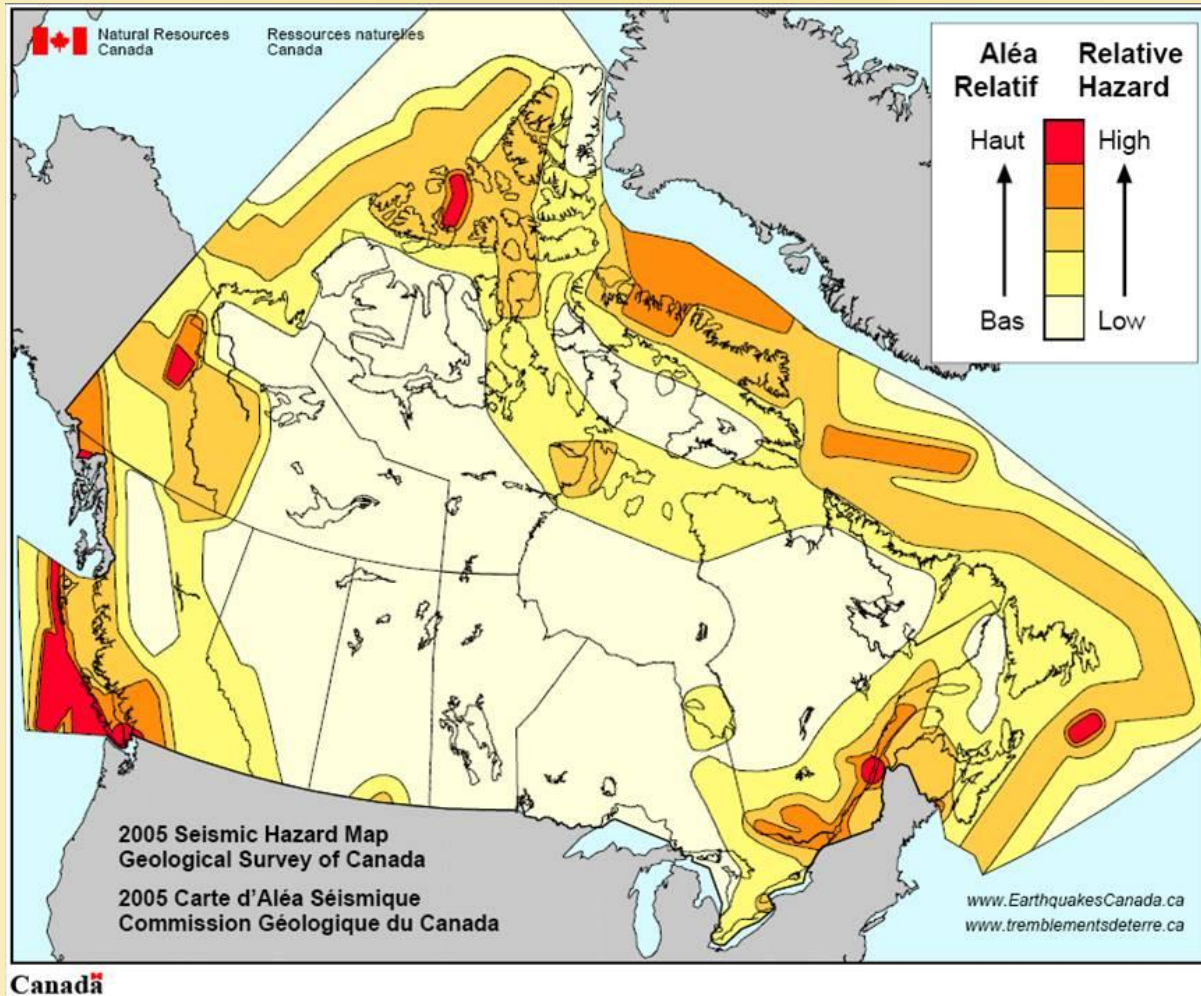


Major Industrial Emitters of CO₂ : 2007



Distribution of Large Stationary CO₂ Sources in Canada

Seismic Hazards in Canada



Canada's Sedimentary Basins Targeted for CCS



Canadian Federal Government

- Legislation requires a 20% reduction in GHG emissions below 2005 levels by 2020
- Announced intentions to require that all new coal-fired and oil sands plants built after 2012 to be capture ready
- Awarded C\$140 M in March 2009 to 7 CCS projects in western Canada under the EcoEnergy Technology Initiative:
 - 4 aquifer storage
 - 2 CO₂-EOR
 - 1 integrated polygeneration plant
- A new 5-years, C\$ 1B Clean Energy Fund was announced this spring:
 - 650 M for large-scale CCS demonstration projects, to be awarded
 - 150 M for research, including CCS
 - 200 M for alternative energy

Alberta Government - 1

- Fossil-fuel based provincial economy (coal-based power generation, oil and gas production, oil sands)
- 100 large sources (>100 kt/yr) account for 50% of emissions, Alberta has ideal geology and potential CCS technology
- Emission intensity targets introduced in 2007 mandate that the ratio of GHG intensity to GDP is 50% by 2020 (allows for population increase and economic development) as opposed to absolute targets
- By 2050 emissions should be less than 50% than in a “Business as Usual” scenario, 70% of which through CCS

Alberta Government - 2

- Climate Change and Emissions Management Fund: \$15/t CO₂, to promote development and diffusion of technologies
- C\$ \$2 B fund to support 3 large-scale CCS demonstration projects that should inject 1 Mt CO₂/year each by 2015
- CCS Development Council to advise on: Technology and Infrastructure, Legal and Regulatory, and Economic aspects of CCS
- Emission Performance Credits, Offset Credits, can be banked and/or traded

CCS Projects in Canada with Federal and Alberta Support

- EPCOR and Enbridge ASAP/Genesee project: post-combustion CO₂ capture from a new IGCC coal-fired power plant and injection into Nisku Fm. carbonate aquifer SE of Edmonton in central Alberta
- Shell's Quest project: Capture of ~ 1 Mt CO₂ from the hydrogen plant at Shell's Scottford bitumen upgrader in Fort Saskatchewan, NE of Edmonton in central Alberta, and injection into the Basal Cambrian sandstone aquifer
- Enhance Energy/Northwest project: capture of CO₂ from bitumen upgrader(s) and fertilizer plants in Alberta's Industrial Heartland NE of Edmonton in central Alberta, and storage in CO₂-EOR operations, including construction of a CO₂ pipeline

CCS Projects in Canada with Federal and B.C. Support

- Spectra Energy Fort Nelson project: capture of 1.2 to 2 Mt CO₂ with H₂S from Spectra's Fort Nelson gas plant in NE B.C., and injection into Keg River Fm. carbonate aquifer
- This project has also USDOE support through the Plains CO₂ Reduction (PCOR) Regional Partnership

CCS Projects in Canada with Federal Support – Saline Aquifers

- TransAlta's Pioneer/WASP project: post-combustion capture of ~ 1 Mt CO₂ from the Keephills coal-fired power plant in the Wabamun Lake area SE of Edmonton in central Alberta, and injection into Nisku Fm. carbonates (aquifer storage) and in CO₂-EOR
- ARC Resources' HARP project: CO₂ capture from one or multiple sources in Alberta's Industrial Heartland, NE of Edmonton, and injection into the carbonate Redwater Leduc reef (aquifer storage)
- Aquistore project: capture of CO₂ from the COOP refinery in Regina, Saskatchewan, and injection into a deep aquifer in the Williston basin (aquifer storage)

CCS Projects in Canada

With Federal Support – CO₂ EOR

- Husky's Lloydminster project: capture of CO₂ from Husky's heavy-oil upgrader and ethanol plant and storage into heavy oil reservoirs in the Lloydminster area

CCS Projects in Canada with Federal Support – Other

- TransCanada's Polygeneration project: Engineering and design work for a polygeneration plant in Belle Plaine, Saskatchewan, that will gasify petcoke to produce electricity, hydrogen, steam and sulphur

Current CCS Projects in Western Canada



National Atlas of CO₂ Storage Capacity in Canada

Technical Decisions

1. Canada will produce its own National Atlas that then will be integrated in NACAP
2. The Atlas will be electronically/GIS based, with a summary hardcopy
3. Only large emitters registered with Environment Canada will be included
4. The Atlas will be based on existing data from public and industry sources, no new data will be acquired (field, lab)
5. Only deep saline aquifers, oil and gas reservoirs and coal beds will be covered

National Atlas of CO₂ Storage Capacity in Canada

Technical Decisions

6. Storage capacity will be evaluated volumetrically for end of injection, later-operating mechanisms (e.g., chemical trapping) and other effects (e.g., pressure build-up) will not be considered
7. The granularity of evaluations should allow aggregation by jurisdiction (province) and/or basin
8. No economic or regulatory considerations will be used except for the expected depth of protected groundwater (currently at 5,000 mg/L, for the Atlas increased at 10,000 mg/L)

National Atlas of CO₂ Storage Capacity in Canada

Technical Decisions

9. A three-step approach will be used:
 - a. Eliminate non-suitable basins based on a suite of “eliminary” criteria (depth, seismic hazard, size, sealing, pressure regime)
 - b. Assess storage potential (good or poor) of remaining basins based on meeting a minimum number of 7 out of 10 “desirable” criteria
 - c. Estimate CO₂ storage capacity for basins with sufficient data

National Atlas of CO₂ Storage Capacity in Canada

Technical Decisions

10. Only uneconomic coals between 600 m and 1000 m deep will be considered
11. Oil and gas reservoirs will be assessed at the reservoir level (not field) and aggregated upwards
12. Currently working on oil and gas reservoirs:
 - a. Single, primary production
 - b. Flooded and/or with strong aquifer support (water drive)
 - c. Comingled
 - d. No CO₂-EOR evaluations

National Atlas of CO₂ Storage Capacity in Canada

Potential Trilateral Activities

- 1. Set up of IT infrastructure for compatibility and integration (databases, platforms, etc.)**
- 2. Work on shared basins: Williston basin in the west, Michigan-SW Ontario-Appalachian in the east**
- 3. Application of methodology for storage capacity coefficients to Canadian basins**

Concluding Remarks

- CO₂ emissions in Canada will continue to grow as a result of population increase, economic development and energy production
- Atmospheric CO₂ emissions will decrease as a result of implementation of energy efficiency and conservation, use of non-fossil energy, and use of CCS in provinces whose economy and power generation is based on fossil fuel
- Currently there are 9 CCS projects in western Canada in various phases of planning and implementation, likely to be operational by 2015 and injecting upwards of 10 M tCO₂/year
- CAP/NACAP is an important project that will provide governments and industry with needed information for decision making

Contact



Dr. Stefan Bachu

Alberta Research Council
stefan.bachu@arc.ab.ca